



SATB2-associated syndrome

SATB2-associated syndrome is a condition that affects several body systems. It is characterized by intellectual disability, severe speech problems, dental abnormalities, other abnormalities of the head and face (craniofacial anomalies), and behavioral problems. Some of the common features can be described using the acronym SATB2 (which is the name of the gene involved in the condition): severe speech anomalies, abnormalities of the palate, teeth anomalies, behavioral issues with or without bone or brain anomalies, and onset before age 2.

Individuals with *SATB2*-associated syndrome typically have mild to severe intellectual disability, and their ability to speak is delayed or absent. Development of motor skills, such as rolling over, sitting, and walking, can also be delayed. Many affected individuals have behavioral problems, including hyperactivity and aggression. Some exhibit autistic behaviors, such as repetitive movements. A happy or overfriendly personality is also common among individuals with *SATB2*-associated syndrome. Less common neurological problems include feeding difficulties and weak muscle tone (hypotonia) in infancy. About half of affected individuals have abnormalities in the structure of the brain.

The most common craniofacial anomalies in people with *SATB2*-associated syndrome are a high arch or an opening in the roof of the mouth (high-arched or cleft palate), a small lower jaw (micrognathia), and dental abnormalities, which can include abnormally sized or shaped teeth, extra (supernumerary) teeth, or missing teeth (oligodontia). Some people with *SATB2*-associated syndrome have other unusual facial features, such as a prominent forehead, low-set ears, or a large area between the nose and mouth (a long philtrum).

Less-commonly affected are the heart, genitals and urinary tract (genitourinary tract), skin, and hair.

Frequency

SATB2-associated syndrome is a rare condition. Its prevalence is unknown.

Genetic Changes

SATB2-associated syndrome is caused by genetic changes that affect the *SATB2* gene. These include mutations within the *SATB2* gene itself and deletions of large pieces of DNA from chromosome 2 that remove the *SATB2* gene and other nearby genes. The *SATB2* gene provides instructions for making a protein that is involved in the development of the brain and structures in the head and face. The SATB2 protein

directs development by controlling the activity of multiple genes in a coordinated fashion.

Researchers suspect that genetic changes affecting the *SATB2* gene reduce the amount of functional SATB2 protein. Reduction of SATB2 function likely impairs normal development of the brain and craniofacial structures, leading to intellectual disability, delayed speech, craniofacial anomalies, and other features of *SATB2*-associated syndrome.

The signs and symptoms of *SATB2*-associated syndrome are usually similar, regardless of the type of mutation that causes it. However, uncommon features of the condition, such as problems with the heart, genitourinary tract, skin, or hair, tend to occur in individuals with large deletions. Researchers suspect these features are related to the loss of other genes near *SATB2*.

Inheritance Pattern

SATB2-associated syndrome is not typically inherited. It results from new (de novo) mutations in the gene that occur during the formation of reproductive cells (eggs or sperm) or in early embryonic development. Affected individuals have no history of the disorder in their family.

Other Names for This Condition

- 2q32 deletion syndrome
- 2q33.1 microdeletion syndrome
- chromosome 2q32-q33 deletion syndrome
- Glass syndrome
- SAS

Diagnosis & Management

Genetic Testing

- Genetic Testing Registry: Chromosome 2q32-q33 deletion syndrome
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C2676739/>

Other Diagnosis and Management Resources

- SATB2gene.com: Making the Diagnosis
<http://satb2gene.com/making-the-diagnosis/>

General Information from MedlinePlus

- Diagnostic Tests
<https://medlineplus.gov/diagnostictests.html>
- Drug Therapy
<https://medlineplus.gov/drugtherapy.html>
- Genetic Counseling
<https://medlineplus.gov/geneticcounseling.html>
- Palliative Care
<https://medlineplus.gov/palliativecare.html>
- Surgery and Rehabilitation
<https://medlineplus.gov/surgeryandrehabilitation.html>

Additional Information & Resources

MedlinePlus

- Encyclopedia: Intellectual Disability
<https://medlineplus.gov/ency/article/001523.htm>
- Encyclopedia: Speech Disorders - Children
<https://medlineplus.gov/ency/article/001430.htm>
- Health Topic: Craniofacial Abnormalities
<https://medlineplus.gov/craniofacialabnormalities.html>
- Health Topic: Developmental Disabilities
<https://medlineplus.gov/developmentaldisabilities.html>
- Health Topic: Speech and Language Problems in Children
<https://medlineplus.gov/speechandlanguageproblemsinchildren.html>

Genetic and Rare Diseases Information Center

- SATB2-associated syndrome
<https://rarediseases.info.nih.gov/diseases/13206/satb2-associated-syndrome>

Educational Resources

- Centers For Disease Control and Prevention: Developmental Disabilities
<https://www.cdc.gov/ncbddd/developmentaldisabilities/>
- Centers For Disease Control and Prevention: Facts About Intellectual Disability
https://www.cdc.gov/ncbddd/actearly/pdf/parents_pdfs/intellectualdisability.pdf
- Foundation for Faces of Children: Cleft Palate
<http://www.facesofchildren.org/Cleft%20Palate>

- KidsHealth from Nemours: Delayed Speech or Language Development
<http://kidshealth.org/en/parents/not-talk.html>
- Merck Manual Consumer Version: Intellectual Disability
<http://www.merckmanuals.com/home/children-s-health-issues/learning-and-developmental-disorders/intellectual-disability>
- Unique: Rare Chromosome Disorder Support Group: 2q33.1 Deletions and Other Deletions Between 2q31 and 2q33
<http://www.rarechromo.org/information/Chromosome%20%202/2q33.1%20deletions%20and%20other%20deletions%20between%20q31%20and%20q33%20FTNP.pdf>

Patient Support and Advocacy Resources

- American Association on Intellectual and Developmental Disabilities
<http://aaidd.org/>
- American Speech-Language-Hearing Association
<http://www.asha.org/public/>
- Children's Craniofacial Association
<http://www.ccakids.com/>
- Cleft Palate Foundation
<http://www.cleftline.org/>
- Foundation for Faces of Children: Cleft Palate
<http://www.facesofchildren.org/Cleft%20Palate>
- Resource List from the University of Kansas Medical Center: Developmental Delay
<http://www.kumc.edu/gec/support/devdelay.html>
- Resource List from the University of Kansas Medical Center: Facial Anomalies/ Craniofacial Conditions
<http://www.kumc.edu/gec/support/craniofa.html>
- SATB2gene.com
<http://satb2gene.com/>
- The Arc: For People with Intellectual and Developmental Disabilities
<http://www.thearc.org/>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28SATB2-associated+syndrome%5BTIAB%5D%29+OR+%28SATB2+haploinsufficiency%5BTIAB%5D%29+OR+%282q33.1+microdeletion+syndrome%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D>

OMIM

- GLASS SYNDROME
<http://omim.org/entry/612313>

Sources for This Summary

- Bengani H, Handley M, Alvi M, Ibitoye R, Lees M, Lynch SA, Lam W, Fannemel M, Nordgren A, Malmgren H, Kvarnung M, Mehta S, McKee S, Whiteford M, Stewart F, Connell F, Clayton-Smith J, Mansour S, Mohammed S, Fryer A, Morton J; UK10K Consortium., Grozeva D, Asam T, Moore D, Sifrim A, McRae J, Hurles ME, Firth HV, Raymond FL, Kini U, Nellåker C, Ddd Study, FitzPatrick DR. Clinical and molecular consequences of disease-associated de novo mutations in SATB2. *Genet Med*. 2017 Feb 2. doi: 10.1038/gim.2016.211. [Epub ahead of print]
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/28151491>
- Britanova O, Akopov S, Lukyanov S, Gruss P, Tarabykin V. Novel transcription factor Satb2 interacts with matrix attachment region DNA elements in a tissue-specific manner and demonstrates cell-type-dependent expression in the developing mouse CNS. *Eur J Neurosci*. 2005 Feb;21(3):658-68.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/15733084>
- Britanova O, Depew MJ, Schwark M, Thomas BL, Miletich I, Sharpe P, Tarabykin V. Satb2 haploinsufficiency phenocopies 2q32-q33 deletions, whereas loss suggests a fundamental role in the coordination of jaw development. *Am J Hum Genet*. 2006 Oct;79(4):668-78.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16960803>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1592575/>
- Britanova O, de Juan Romero C, Cheung A, Kwan KY, Schwark M, Gyorgy A, Vogel T, Akopov S, Mitkovski M, Agoston D, Sestan N, Molnár Z, Tarabykin V. Satb2 is a postmitotic determinant for upper-layer neuron specification in the neocortex. *Neuron*. 2008 Feb 7;57(3):378-92. doi: 10.1016/j.neuron.2007.12.028.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/18255031>
- Dobrev G, Chahrour M, Dautzenberg M, Chirivella L, Kanzler B, Fariñas I, Karsenty G, Grosschedl R. SATB2 is a multifunctional determinant of craniofacial patterning and osteoblast differentiation. *Cell*. 2006 Jun 2;125(5):971-86.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16751105>
- Zarate YA, Fish JL. SATB2-associated syndrome: Mechanisms, phenotype, and practical recommendations. *Am J Med Genet A*. 2017 Feb;173(2):327-337. doi: 10.1002/ajmg.a.38022. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/27774744>
- Zarate YA, Kalsner L, Basinger A, Jones JR, Li C, Szybowska M, Xu ZL, Vergano S, Caffrey AR, Gonzalez CV, Dubbs H, Zackai E, Millan F, Telegrafi A, Baskin B, Person R, Fish JL, Everman DB. Genotype and Phenotype in 12 additional individuals with SATB2-Associated Syndrome. *Clin Genet*. 2017 Jan 31. doi: 10.1111/cge.12982. [Epub ahead of print]
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/28139846>

Reprinted from Genetics Home Reference:

<https://ghr.nlm.nih.gov/condition/satb2-associated-syndrome>

Reviewed: February 2017
Published: March 21, 2017

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services